

PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

Improved Poultry Feed

We, CENTRAL SOYA COMPANY, INC., a corporation organized and existing under the Laws of the State of Indiana, United States of America, of 300 Fort Wayne Bank Building, Fort Wayne, 2, State of Indiana, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a poultry-feed for the skin pigmentation of poultry through the use of soybean xanthophylls. This invention is particularly useful in providing great flexibility in the formation of feeds for poultry, and particularly chickens and turkeys, and in solving the problem of shortage in xanthophylls while utilizing a by-product or waste product in the soybean industry for feeding purposes.

It is well recognized in poultry nutrition that as a result of feeding of xanthophyll to certain varieties of fowl—usually incorporated in maize, maize gluten meal, dehydrated alfalfa, and in the form of various concentrates of these ingredients—pigmentation of the skin occurs. Skin pigmentation is highly desirable in marketing poultry products. In certain areas, where xanthophyll-deficient grains are extensively used, there also may be a problem of obtaining desirable colouring of egg yolk. This again can be achieved by boosting the xanthophyll content of a laying ration.

One of the problems in poultry feed formulations for some years has been the finding of an economical source of xanthophyll. The most common source of xanthophyll is yellow maize. The quantities of this ingredient used in feeds, however, are not sufficient to supply optimum pigmentation. Maize gluten meal has been added, therefore, in most cases, as a primary supplementary source of xanthophyll.

[Price 4s. 6d.]

Dehydrated alfalfa and various xanthophyll concentrates are also considered as possible sources.

There are certain disadvantages in using these conventional supplements. Laboratory findings indicated great variations in the xanthophyll content of maize gluten meal (105—255 mcg/gm i.e. micro/gram) from time to time, and even with good quality gluten meal, approximately 5% has to be added to give satisfactory, but not outstanding, results. Current production of maize gluten meal ranges from 200 to 250 thousand tons annually. If all production of maize gluten meal were exclusively assigned to broiler feeds, there would not be sufficient gluten meal to provide the minimum level in this quantity for the estimated 6 million tons of broiler feeds produced annually in the United States of America.

Research publications reveal that xanthophyll in dehydrated alfalfa (150—500 mcg./gm) is not as effectively utilized as from other sources, and also is subject to a much higher degree of instability. Furthermore, extensive use of alfalfa meal in high energy broiler feeds interferes with feed efficiency objectives by reason of the resultant higher fibre and lower energy content of such feeds.

Commercial concentrates of xanthophyll from various feed ingredients to date are very expensive and cannot be produced in large quantities.

Soybean oil itself and the most common by-products of soybean oil have never been considered as a potential source for pigmentation. The reasons for this are the relatively low xanthophyll content of the oil and lecithin, and the fact that the soapstocks are generally acidulated, whereby the xanthophyll is destroyed.

Other problems relating to feeds for poultry

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have to do with better feed absorption, the dustiness of the product, and its lack of free-flowing particles. Further, when ingredients such as maize gluten meal or alfalfa are employed, there is difficulty in obtaining the proper balance in the formulation, and the desired flexibility of formulation is lacking. For example, it is often necessary to incorporate more maize gluten meal than is desired from the standpoint of a balanced feed, and in the case of alfalfa, there is considerable instability which affects the performance of a feed after movement through marketing channels. There has long been a need for a source of xanthophyll which would be free of undesirable qualities affecting the formulation flexibility while at the same time having properties aiding better feed absorption by the poultry, reducing the dustiness of the product and increasing the free-flowing characteristics of the product.

We have discovered that while soybean meal and soybean oil itself has a relatively low xanthophyll content, it is possible to obtain a surprisingly large concentration of stable and easily available xanthophyll in the soapstock fraction that occurs during soybean process-

ing. We have found that soapstock enables an effective feed to be produced of high stability and which can be efficiently utilized by poultry while effecting the desired pigmentation thereof. There is thus permitted a high flexibility in formulation and a high stability in the resultant feed. Soybean xanthophyll has much higher stability and is utilized with greater feed efficiency than the conventional xanthophyll supplements heretofore employed.

An object of the present invention is to employ soybean oil soapstocks to provide highly flexible feed formulations which are stable and which may be efficiently utilized in the pigmentation of broilers.

Another object is to provide a feed composition in which soapstocks are employed for increasing the palatability of the feed materials while also providing a nonpelleted feed substantially free of dust and having free-flowing properties. Other specific objects and advantages will appear as the specification proceeds.

The following is the xanthophyll content of an average quality feed ingredient and an average quality soybean oil product:

Ingredient	Xanthophyll mcg/gm
1 Milo	3
2 Soybean oil meal	2
3 Maize	22
4 Maize gluten meal	154
5 Dehydrated alfalfa	330 (not efficiently utilized)
6 Crude soybean oil	67
7 Lecithin (dry)	214

55 In contrast with the above, we have discovered that a surprising amount of xanthophyll can be obtained from soybean oil frac-

tions obtained in the processing of the soybean oil. For example, the following fractions have the indicated xanthophyll content:

Ingredient	Xanthophyll mcg/gm
8 Soybean soapstock from crude oil (dry)	1000
9 Soybean soapstock from degummed oil (40% moisture)	1050
10 Soybean soapstock from degummed oil (dry)	1750

From the above, it will appear that the soapstock and its by-products provide an excellent source of xanthophyll while at the same time, because of the alkaline or the inert medium in which these products are prepared, their xanthophyll content is well preserved.

Soybean oil soapstock can be used as is, or dried, in formulations. The alkaline nature of soapstock will protect its xanthophyll from rapid storage deterioration. Colour bodies or pigments from various decolorization processes can yield the multiple amount of xanthophyll that is found in soapstock. They can be added directly to the formulas. Nevertheless, soapstock lends itself as an ideal carrier for these materials because of its alkalinity, tocopherol and phosphatide content, which attributes make soapstock a good antioxidant.

In addition to the above advantages, it is found that the soapstock or the soapstock concentrate has an emulsifying action in the intestinal tract which aids better feed adsorption; it eliminates the dustiness of the product, causes the feed to have free-flowing particles, and provides a lubricating effect which reduces frictional heat in pelleting the feeds. The soapstock has high caloric value, a high unsaturated fatty acid content, gives the feed a better colour.

In the alkali refining of soybean oil, an alkali, such as, for example, caustic soda (NaOH), is added to the soybean oil in a tank in sufficient amounts to neutralize the free fatty acids contained in the soybean oil. The soaps formed are herein referred to as 'soapstock'. The soapstock has a remarkable affinity for xanthophyll and in settling picks up the xanthophyll and carries it to the bottom of the tank. In the usual batch operation, the soaps settle in a quiescent operation and are deposited with the xanthophyll in the bottom of the tank. The soybean oil is then decanted, leaving the soapstock in the bottom of the tank, which may then be drawn out as wet soapstock or heated to evaporate the volatile matter to obtain dry soapstock. In a continuous process, the soaps are removed by centrifugal separation. In each instance, the soap entrains the xanthophyll pigment in the concentrated form described hereinafter.

Soapstock contains a saponified fatty acid fraction, a phosphatide and sterol fraction, together with some of the pigments of the oil. It is a known market commodity. It is a high

energy source, containing approximately 70% of fatty acids. Its emulsified character and surfactant properties aid in the absorption of feed, as stated. The alkaline character of the material aids greatly in stabilizing the xanthophyll content.

On a wet basis, it is preferred to add 2-4% of the soapstock to the feed. On a dry basis, it is preferred to add 1-2% soapstock to the feed. Not only is the amount added extremely small while at the same time giving the desired pigmentation, but the added material has a higher energy content, and by reason of its effectiveness in producing good colouration, great flexibility is permitted in the formulation of the feeds.

While the literature has indicated that there are small amounts of xanthophyll in soybean oil, it came as a surprise to us to find the large concentration of xanthophyll in the soapstock fraction of the soybean oil and to find further the high content of xanthophyll in an alkaline medium by which it is stabilized.

Degummed soybean oil is crude soybean oil to which has been added water to hydrate the phosphatides, the phosphatides being then removed by centrifugal separation.

Since 0.1-3% of soybean oil xanthophyll material added to the feed can give excellent results by furnishing part or all of the 10,000-12,000 units (mcg) of xanthophyll per pound of feed over a period of 3-4 weeks of feeding which is necessary for good pigmentation, it affords great flexibility in formulation by permitting the addition of more economical ingredients which are equivalent or even superior to the conventional xanthophyll contributing ingredients, i.e., maize gluten meal, dehydrated alfalfa, in regard to caloric content or protein quality. One unit, as referred to above, equals one microgram.

By way of illustration, the following rations have been used for broilers and will be designated in the Examples to follow as the basal diets:

Concentrate (to be mixed with local grain) 100
If 70% maize is used, this will supply 7000 units of the necessary 12,000. This means that 30% of a protein-vitamin-mineral concentrate must supply 5000 additional units in the ration or $5000 \times 3.33 = 16,600$ units per pound.

This can be done the conventional way by incorporating into the concentrate:

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15% Maize gluten meal x 70,000	=	10,500 units
4% Dehydrated alfalfa x 150,000	=	6,000 "
		<u>16,500</u> "

BROILER FEED

70% Maize x 10,000	=	7,000 units
5% Maize gluten meal x 70,000	=	3,500 "
1% Dehydrated alfalfa x 150,000	=	1,500 "
		<u>12,000</u> "

* * *

The following Examples will illustrate the provided by this invention: economics and flexibility of formulation as

EXAMPLE ICONCENTRATE:

10% Maize gluten meal x 70,000	=	7,000 units
5% Soybean Oil Soapstock (crude, dry) (1000 mcg/gm) (454,000 x 0.02)	=	9,080 "
		<u>16,080</u> "

Replacement of xanthophyll from 5% maize 2% dry soybean oil soapstock in the conventional formula by conventional formula.

EXAMPLE IICONCENTRATE:

10% Maize gluten meal x 70,000	=	700 units
2% Soybean Oil Soapstock (degummed, dry) (1,750 mcg/gm)	=	15,900 "
		<u>16,600</u> "

Replacement of xanthophyll by 14% maize 2% dry soybean soapstock from degummed gluten meal and 4% dehydrated alfalfa by oil.

EXAMPLE IIICONCENTRATE:

15% Maize gluten meal x 70,000	=	7,000 units
2% Soybean Soapstock from degummed oil (40% moisture) (1,050 mcg/gm)	=	9,500 "
		<u>16,500</u> "

Replacement of xanthophyll from 5% corn undried (40% moisture) soybean soapstock
gluten meal and 4% dehydrated alfalfa by 2% from degummed oil.

EXAMPLE IV

CONCENTRATE:

	1% Dehydrated alfalfa	=	1,500 units
	8.5% Maize gluten meal x 70,000	=	5,950 "
5	0.5% Mixture of 3 parts of Xanthophyll concentrate obtained by solvent extraction of soybean soapstock (10,500 mcg/gm) and 7 parts of wet soybean soapstock (carrier) described in Example III (3,885 mcg/gm)	=	8,825 "
			<u>16,275 "</u>

Replacement of xanthophyll from 6.5% maize gluten meal and 3% dehydrated alfalfa by 0.5% soybean oil xanthophyll concentrate in a soapstock carrier.

EXAMPLE V

FEED:

	70% Maize x 10,000	=	7,000 units
10	1% Maize gluten meal x 70,000	=	700 "
	1% Soybean Oil Soapstock (crude, dry) (1,000 mcg/gm)	=	4,540 "
			<u>12,240 "</u>

Replacement of xanthophyll from 4% corn gluten meal and 1% dehydrated alfalfa by 1%

EXAMPLE VI

FEED:

	30% Milo or Wheat	=	negligible
	40% Maize x 10,000	=	4,000 units
	5% Maize gluten meal x 70,000	=	3,500 "
	1% Soybean Soapstock from degummed oil (40% moisture) (1,050 mcg/gm)	=	4,750 "
			<u>12,250 "</u>

15 Replacement of xanthophyll equivalent to 1% wet soybean soapstock from degummed 30% of corn and 1% dehydrated alfalfa by oil.

EXAMPLE VII

FEED:

70% Milo	=	negligible
4% Maize gluten meal x 70,000	=	2,800 units
0.2% Xanthophyll concentrate from solvent extraction of soybean soapstock (10,500 mcg/gm)	=	9,500 "
		<u>12,300 "</u>

5 Replacement of xanthophyll equivalent to 70% maize, 1% maize gluten meal and 1% dehydrated alfalfa by 0.2% xanthophyll concentrate from soybean soapstock.

EXAMPLE VIII

Xanthophyll Supplement:

10 Mixture of 9 parts of xanthophyll concentrate from solvent extraction of soybean soapstock and 1 part of wet (40% moisture) soybean soapstock from degummed oil.

$$10,500 \times 0.9 = 9,450 \text{ units}$$

$$1,050 \times 0.1 = 105 "$$

$$\underline{\underline{9,555}}$$

The following diets were fed to chickens and at the end of the feeding test the depot fat of broilers was extracted and analyzed 15 spectrophotometrically at 436 mu.

	Diets	Xanthophyll Mcg/gm	1% E 1 cm at 436 mμ	Pigmenta- tion Index*
1.	70% Wheat basal	3.53	0.0103	63.0
2.	70% Wheat basal + de-gummed oil soapstock	20.85	0.0331	203
3.	70% Wheat basal + 4% de-gummed oil soapstock	40.00	0.0473	290
4.	30% Wheat basal + 40% maize + 2% maize gluten meal	16.78	0.0167	102
5.	30% Wheat basal + 40% maize + 2% maize gluten meal + 3% crude oil soapstock	27.60	0.0203	124
6.	30% Wheat basal + 40% maize + 2% maize gluten meal + 6% crude oil soapstock	34.75	0.0312	191
7.	30% Wheat basal + 40% maize + 2% maize gluten meal + 3% mixed degummed and crude oil soapstock	28.00	0.0261	160
8.	30% Wheat basal + 40% maize + 2% maize gluten meal + 6% mixed degummed and crude oil soapstock	38.50	0.0337	201
9.	Control commercial broiler feed	26.33	0.0163	100
10.	70% Maize basal + 1-1.5% degummed oil soapstock	37.10	0.0258	158
11.	70% Maize basal + 3% de-gummed oil soapstock	50.00	0.0348	213
12.	70% Maize basal + 10% maize gluten meal + 3% alfalfa	49.25	0.0284	174

* Percentage values are based on sample # 9, a commercial broiler feed as 100.

These results show the direct relationship between xanthophyll content of the diet and pigment deposition in the fowl. It is also apparent that the addition of a soybean xanthophyll source gives a response similar to or better than that obtained by xanthophyll derived from conventional feed ingredients.

As heretofore indicated, there is obtained through the soapstock, de-colourising or bleaching operations, a xanthophyll concentrate having 1000 or more MCG/gm of xanthophyll, the content running from 1000 mcg/gm

in the soybean soapstock from crude oil (dry), up to 10,500 mcg/GM from a concentrate from soapstock. The percentage of the vehicle will be increased or diminished depending upon the vehicle content of xanthophyll. For the purpose of stability, it is preferred to have the composition either alkaline or neutral.

The feed may be in the form of final feed or in a concentrate such as a broiler concentrate. If it is desired that in the final feed there be a certain percentage of the soybean oil fraction, a concentrate may be prepared for

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convenience in sale and shipping, the concentrate having, of course, a larger percentage than will be needed for the final feed supplied to the poultry, the poultry farmer supplying additional feed components. It is found that an effective feed composition for the treatment of poultry to effect the various results herein described may contain, in addition to the normal poultry feed components, from 0.1 to 8.0% of a soybean oil fraction containing at least 400 units of xanthophyll per gram of said fraction. Where the unitage is higher, say between 3,000 to 50,000 units, the oil fraction should be in the range of 0.05 to 1.0% depending upon the degree of pigmentation desired. Lecithin sludge may be used along with the soybean oil fraction, and we prefer to use it in a dry form. While the soapstock may be mixed with the feed at any stage, we find that best results are obtained when the soapstock is dried prior to mixing with the feed. In any event, the relative amount of the soybean oil fraction is so small that great flexibility is permitted in the feed formulations, and the nutrients supplied by the other feed components in the mixture can be furnished to the poultry in the desired proportions, little attention being required for the xanthophyll content since it is supplied in a concentrated form by the small amount of the soybean oil fraction.

While, in the foregoing specification, we have set forth specific compositions or examples in considerable detail for the purpose of illustrating the invention, it will be understood

that such details may be varied widely by those skilled in the art without departing from the scope of the invention as defined in the appended claims.

WHAT WE CLAIM IS:—

1. A process for the manufacture of poultry feed comprising the steps of alkali-refining soybean oil containing xanthophyll to form soapstock as hereinbefore defined, which collects the xanthophyll therein in a concentrate

having at least 400 units of xanthophyll per gram of soapstock on a dry basis, separating the soapstock from the refined soybean oil and drying and mixing at least 1% on a wet basis of soapstock which is alkaline in character and contains said concentrate of xanthophyll with poultry feed.

2. The process as claimed in claim 1 in which said soapstock is dried prior to admixture with the poultry feed.

3. The process as claimed in claim 1 in which said soapstock is dried in admixture with dried poultry feed.

4. A modification of the process as claimed in claim 1 comprising separating the soapstock from the refined soybean oil, and drying and mixing at least 1% on a dry basis of said soapstock which is alkaline in character with poultry feed.

5. A poultry feed substantially as set forth in any of the foregoing examples.

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